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Woody-Plant Succession in an Eastern Nebraska Bluff Forest

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Woody plant composition of ridgetop old-fields abandoned at various times since 1800 suggest a successional pattern for an eastern Nebraska bluff forest. Sites abandoned for 24 years were dominated by elm (*Ulmus* spp.) and rough-leaved dogwood (*Cornus drummondii*). Other sites, abandoned for 76 years, were dominated by bitternut hickory (*Carya cordiformis*), American linden (*Tilia americana*), and hop-hornbeam (*Ostrya virginiana*), and those abandoned for 186 years were predominantly bur oak (*Quercus macrocarpa*) and hop-hornbeam. Based on species importance values, we conclude that the composition of this forest is still changing.

INTRODUCTION

According to field notes of the original land survey conducted in 1856, pre-settlement forest stands occurred at various locations along the Missouri River in east-central Nebraska. Descriptions of the woody vegetation of these forests, particularly the hilltop and upper slope portions, indicate dominance by bur oak (*Quercus macrocarpa*) and bitternut hickory (*Carya cordiformis*) (Aikman, 1926; Weaver, 1965). Portions of these river bluffs, however, were prairie which, in many locations, may have been subsequently replaced by trees and shrubs (Heineman, 1982). No studies have been published, however, that describe woody-plant succession in these eastern Nebraska forest, although Loomis and McComb (1944) suggested that the climate of the region could accommodate a succession from prairie to oak-hickory forest. The absence of this information led to the present preliminary study, the objective of which was to infer successional changes over time in an east-central Nebraska bluff forest by evaluating the present woody plant composition of abandoned old-fields.

METHODS

The study sites are in Fontenelle Forest, a privately-owned forest on the bluffs of the Missouri River in Sarpy County, Nebraska, south of Omaha. The preserve is presently maintained with a minimum of disturbance to the existing woodland.

Five sites in the forest were identified that had been cleared and subsequently abandoned at various times since 1800. To control for effects of topography, only hilltop sites were selected. These five sites, referred to here by the place-names used by forest personnel, are (1) Prairie Site, abandoned

in 1962; (2) Bladdernut Site, abandoned in 1936; (3) East Oak Site, abandoned in 1936; (4) Signal Ridge Site, abandoned in 1910; and (5) West Oak Site, abandoned in 1800. Dates of abandonment are from Garabrandt (1978).

Within each site, woody plants with a diameter at breast height (dbh) greater than 2 cm were evaluated in April, 1986, using the point-quarter method of Cottam and Curtis (1956). The minimum dbh of 2 cm was selected after a preliminary evaluation that indicated that this size would eliminate a large portion of the understory shrubs that are not the focus of this study. In addition, this size limit reduced the adverse effects of sampling only 20 points, which normally is too small a sample to describe adequately all woody plants at a site. The number of points was limited to 20 because of the small size of the sites and the need to prevent repeated sampling of individual trees. Importance values (IV) were calculated for each species by summing relative dominance, relative frequency, and relative density.

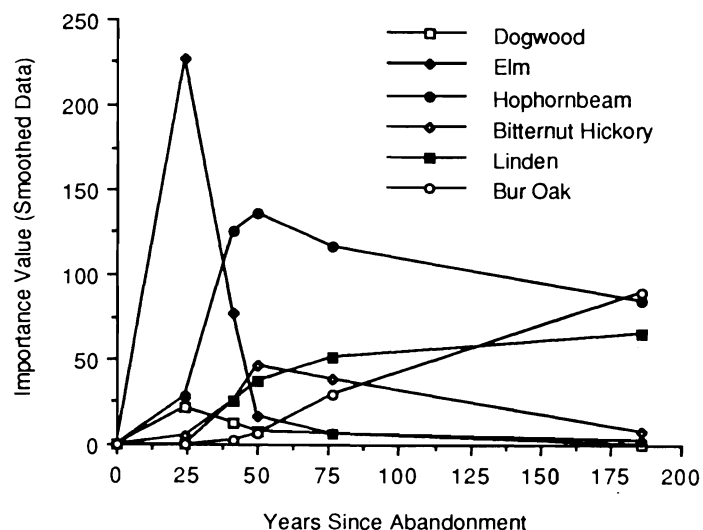


FIGURE 1. Woody-plant succession suggested by data from the study at Fontenelle Forest. Elm, hickory, linden, and bur oak are dominant at 25, 50, 75 and 175 years since abandonment, respectively; they form the uppermost canopy that dominates the sere (dogwood and hophornbeam are not canopy species).

TABLE I. Importance values (IV) of woody plants in five fields abandoned in various years since 1800. Evaluations were conducted in 1986, recording only species in more than one site.

SPECIES	Sites (years since abandonment)				
	1(24)	2(41)	3(50)	4(76)	5(186)
Elm <i>Ulmus americana</i> , <i>U. rubra</i>	227	31	19	0	3
Rough-leaved dogwood <i>Cornus drummondii</i>	22	14	3	12	0
Hop hornbeam <i>Ostrya virginiana</i>	28	179	115	134	85
Redbud <i>Cercis canadensis</i>	12	6	20	14	0
Bitternut hickory <i>Carya cordiformis</i>	5	17	62	41	8
American linden <i>Tilia americana</i>	0	42	25	56	66
Hackberry <i>Celtis occidentalis</i>	0	7	42	7	22
Shagbark hickory <i>Carya ovata</i>	0	4	0	19	19
Bur oak <i>Quercus macrocarpa</i>	0	0	6	10	90
Silver maple <i>Acer saccharinum</i>	0	0	5	0	4
Green ash <i>Fraxinus pennsylvanica</i>	0	0	3	0	4

RESULTS AND DISCUSSION

The most recently abandoned sites (abandoned in 1962) were dominated by elm (*Ulmus* spp.; IV 227) with an understory primarily of rough-leaved dogwood (*Cornus drummondii*; IV 22)(Table I; Fig. 1). Sites abandoned for approximately 50 years were dominated by bitternut hickory (IV 62) and hackberry (*Celtis occidentalis*; IV 42), with a substantial amount of hop-hornbeam (*Ostrya virginiana*; IV 115) an understory species. Elm was also present in this community, although it was considerably less important than in earlier stages; the extent to which Dutch elm disease contributed to its decline is not apparent from this study. Sites abandoned for 76 years were not substantially different from the 50-year sites, although elm was low and American linden (*Tilia americana*; IV 56), shagbark hickory (*Carya ovata*; IV 19), and bur oak (IV 10) were higher.

Approximately 180 years following abandonment, the dominant canopy species were bur oak (IV 90) and American linden (IV 66), with hop-hornbeam (IV 84) an important understory tree. Bitternut hickory was present but substantially less important (IV 8) than in sites abandoned earlier. Elm was low and rough-leaved dogwood was absent from this, the oldest site evaluated.

Because of the extensive disturbance of the study area over the years, it is difficult to assess the degree to which these old forest stands are relatively stable in composition. However, general observations, such as the absence of bur oak regeneration, suggest that species composition of Fontenelle Forest is changing. Studies in other bur-oak dominated forests reach the same conclusion (Beightol, 1986). Further study is needed both to assess the dynamic status of the bluff forest ecosystem and to substantiate the successional pattern implied from this preliminary study. Evaluations of other sites in eastern Nebraska are needed to assess further the degree to which changes at this location characterize overall successional patterns along the Missouri River bluffs of Nebraska and Iowa.

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